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RECTIFIER
[Gleichrichter]

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Patent Claims

1. A rectifier for demodulating amplitude-modulated electric HF oscillations, wherein the input-side HF voltage is converted into an HF current proportional to the HF voltage before rectification and the rectified current is reconverted into a voltage.

2. The rectifier according to Claim 1, wherein the HF current has a direct current portion that is greater than the maximum HF current and the average value of the direct voltage at the input of the rectifier part of the circuit is held at a predetermined level by a control circuit (IC1, R7, C4).

3. The rectifier according to Claim 1, wherein the voltage-current-converter (1) contains a pnp-transistor (T1) and an npn-transistor (T2), that are in series with emitter resistors (R5, R6) at a supply voltage ($+U_B$, $-U_B$) and the interconnected collectors of the two transistors (T1, T2) are connected with the input of the rectifer circuit.

4. The rectifier according to Claim 3, wherein an oscillating circuit (L, C5) is grounded in series with a condenser (C6) at the input of the rectifier circuit and the oscillating circuit (L, C5) is tuned to the carrier frequency of the HF signal on the input side with inclusion of the inherent capacitances of the adjacent components (T1, T2, D1, D2).

Description

The invention concerns a rectifier according to the preamble of Claim 1.

A rectifier of this kind is described in DE patent specification 24 22 030. In this circuit, the HF signals lie directly on two diodes

connected anti-parallel at high frequencies via series resistors. The bias voltage in each case is set so that there is also a linear dependence on current and voltage in the starting range, that is, in the range of low input voltages. This rectifier arrangement has a dynamic range of around 50 dB.

The object of the invention is to create a rectifer arrangement that has a greater dynamic range than 50 dB.

This object is achieved by the features indicated in Claim 1. The sub-claims present advantageous configurations of the object of the invention.

The advantages obtained by the invention in particular consist in the fact that the high-frequency voltage on the input side is converted into proportional high-frequency currents that provide a direct current source provide, that the current cumulative point is constantly held at zero volts by a control circuit, that the signal current obtained by the rectification is reconverted into a voltage, and that the parasitic capacitances are compensated in the circuit by incorporation of the same into an oscillating circuit. A dynamic range of around 80 dB can be obtained with this circuit.

A specific embodiment of the invention is explained in greater detail below in connection with a drawing.

The drawing shows a circuit diagram of a rectifier that is used for demodulating amplitude-modulated HF oscillations. The circuit is composed of four function blocks:

I. constant voltage creation

II. zero volt control

III. capacitance compensation

IV. rectification and voltage conversion

Block I is a voltage-controlled HF voltage source. It essentially consists of a pnp-transistor **T1** and an npn-transistor **T2**, that are in series with emitter resistors **R5** and **R6** between $+U_B$ and $-U_B$ of the supply voltage. The basic transmission distances of the two transistors **T1** and **T2** are biased via voltage dividers **R1/R2** and **R3/R4** so that a closed-circuit current, that is greater than the maximum HF current appearing, flows via the collectors. The condensers **C1** and **C2** are used for direct current decoupling of the working points of the transistors **T1** and **T2** adjusted via the current dividers **R1/R2** and **R3/R4**. The condenser **C3** is used exclusively for improving the circuit symmetry.

The interconnected collectors of the two transistors **T1** and **T2** of the above-mentioned function block I are connected with the input of the rectifier circuit of block IV.

The transistors **T1** and **T2**, as well as diodes **D1** and **D2** of the rectifier circuit have inherent capacitances. The latter have a negative effect in signal preparation. For this reason an oscillating circuit **L/C5** is grounded by a smoothing condenser **C6** (Block III) at the input of the rectifier circuit. The oscillating circuit **L/C5** is tuned to the carrier frequency of the input signal U_E via **C5**, the parasitic capacitances of the adjacent components being automatically included, so that their interference effect for the resonance frequency is eliminated.

The average voltage value on the collector distance must be exactly zero volts, so that no fault voltages are obtained at the output. This condition would be fulfilled by a fully symmetrically

designed constant current source, that is, when **C1=C2**, **R1=R4**, **R2=R3**, **R5=R6**, **T1=T2**, and *+UB*=*-UB*. The requirement imposed cannot be fulfilled without special measures because of the production scattering of the electric values of the components. For this reason, a control circuit, via which the working point of the transistor **T1** can be adjusted, is provided for zero point control (block II). Therefore the resistor **R2** of the voltage divider **R1/R2** is not grounded, as **R3**, but is placed on the output of an integrator **IC1/C4**, that for its part is connected with the inverting input via a resistor **R7** to the hot end of the smoothing condenser **C6**. The voltage level prevailing on the collectors of the transistors **T1** and **T2** occurs on the inverting input of the integrator **IC1/C2** via the inductance **L** of the oscillating circuit and the resistor **R7**. When the existing voltage deviates from the ground potential (zero volts) the integrator always generates a corresponding inverted output voltage. In this way the working point of the transistor **T1** is shifted so that the average voltage value present on the collectors of transistors **T1** and **T2** amounts to zero volts.

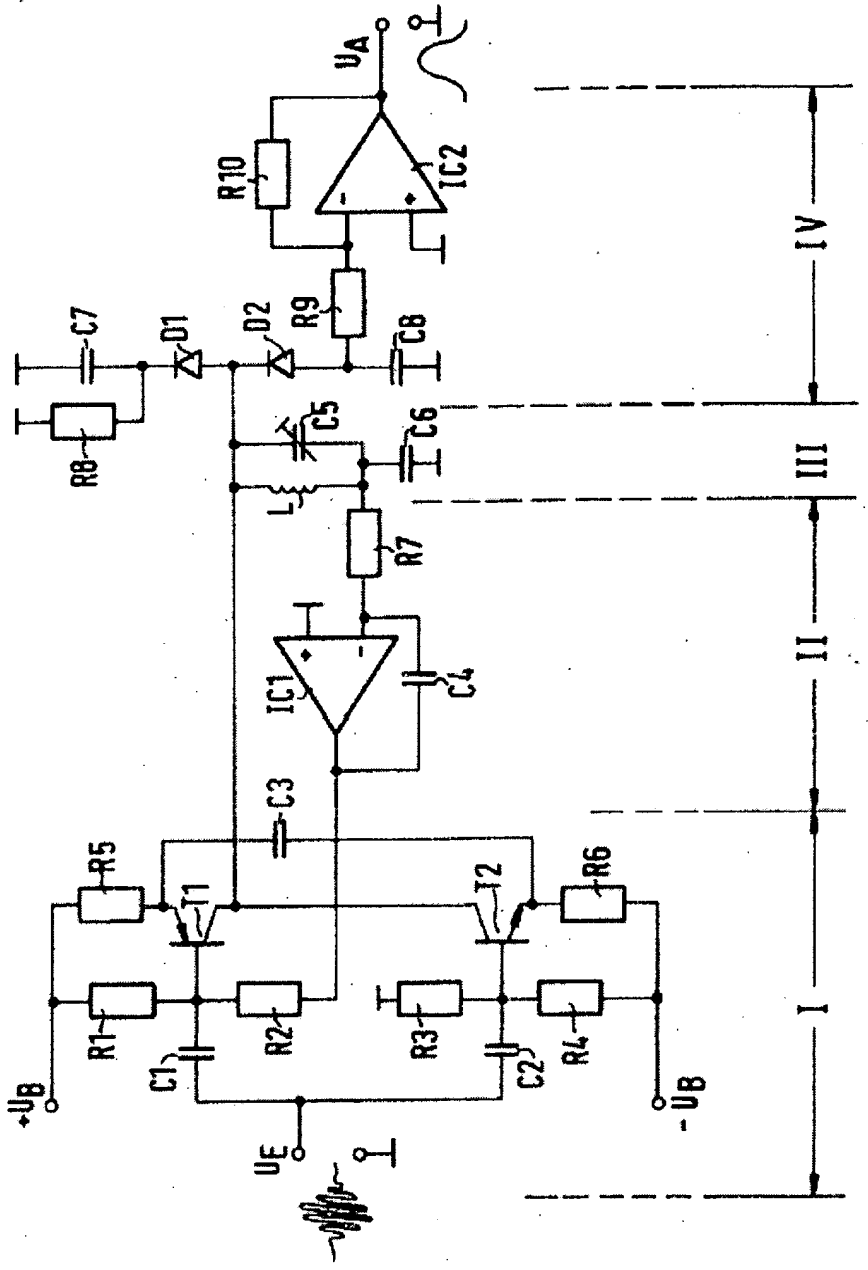
The demodulation of the HF current takes place in block IV in a way known per se through a rectifier circuit having two parallel branches, into which diodes **D1** and **D2** are introduced with opposite pass direction. In the case of the present circuit example, only the branch of the rectifier circuit with diode **D2** is used, so that the demodulated output signal U_A is obtained only from the current of a half-wave. The object of the branch with diode **D1** is only to obtain electric symmetry of the circuit. Diodes **D1** and **D2** are grounded in series with a smoothing condenser **C7**, respectively **C8**. While the

condenser **C7** is bridged by a discharge resistor **R8**, the ground end of diode **D2** is connected via a resistor **R9** with an inverting input (-) of an operation amplifier **IC2**, of which non-inverting input (+) is grounded and that is counter-coupled by a resistor **R10**.

The circuit described above functions as follows: as already explained, the bias voltage of the two transistors **T1** and **T2** is adjusted via the voltage dividers **R1/R2** and **R3/R4** so that a closed-circuit current flows through the two transistors **T1** and **T2**, that is greater than the maximum appearing HF current, in the uncontrolled state. Ground potential (zero volts) prevails on the collector distance both transistors **T1** and **T2** because of the zero volt control of block II. If an amplitude-modulated HF signal appears at the input of the circuit, the basic transmitter voltage of the two transistors **T1** and **T2** varies depending on the polarity of the carrier frequency and the amplitude level in each case by the same amount ∀)U. With this the voltage ratios remain unchanged on the collector distance (supported by **C3**), but the current fluxes through the transistors **T1** and **T2** vary in the amount in the opposite direction proportional to the signal amplitude. The consequence is that the collector currents are of different sizes. The difference of these currents is superposed on the two diodes **D1** and **D2** of the rectifier circuit. The forced current flux also causes a linear demodulation in the starting range of diodes **D1** and **D2**.

In order to avoid a fault voltage at the output, all HF oscillations deviating from the carrier frequency, present in the signal because of interference inputs are discharged via the oscillation circuit **L/C5** and the condenser **C6**. The condenser **C8** used

for residual smoothing of the still existent HF portions represents a nearly infinite resistance for the modulation frequency. Therefore the direct current given the modulation frequency passes via the resistor **R9** to the operation amplifier **IC2,** via which the modulated direct current is restored to a proportional output voltage U_A in connection with the feedback resistor **R10.**


UA
R10
IC2
C7
D1
D2
R9
C8
R8
C5
C6
L
R7
IC1
C4
C3
R5
T1
T2
R6
R1
R2
R3
R4
C1
C2
+UB
-UB
UE
IV
III
II
I